

ENDANGERED *Species* BULLETIN

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*The interrelationships among plants, animals, and their environments are fascinating and often complex. By learning more about these interactions, scientists, resource managers, and landowners can go beyond the protection of individual species and work toward protecting these critical linkages in natural systems. Flowering plants, for example, sometimes need specific birds and insects for pollination, while some butterfly larvae require a specific host plant for food. Certain predators depend on a single prey species. This edition of the **Endangered Species Bulletin** looks at various ways in which the decline of some plants and animals, and their prospects for recovery, are related directly to the fate of other species.*



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Cover and Left

Looking like a cabbage on a baseball bat, *Brighamia insignis* has a thick, succulent stem topped by a cluster of broad leaves. One of the main threats to this plant is the loss of native pollinators.

photos by Steve Perlman

Opposite Page

The Vermilion Cliffs, north of the Grand Canyon in Arizona, are the site of a new California condor reintroduction effort.

photo by Michael Bender

The Endangered Species Bulletin welcomes manuscripts on a wide range of topics related to endangered species. We are particularly interested in news about recovery, habitat conservation plans, and cooperative ventures. Please contact the Editor before preparing a manuscript. We cannot guarantee publication.

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As Goes the Prairie Dog

The black-footed ferret (*Mustela nigripes*) evolved on the North American prairie when the prairie dog (*Cynomys* sp.), the prey on which the ferret depends, inhabited approximately 100 million acres (2.5 million hectares). The historical range of ferrets and prairie dogs roughly overlapped and extended across 12 States, from western Canada to Mexico, although the ferret was never a commonly observed animal. Prairie dog habitat has been reduced by about 98 percent from former levels. What remains is fragmented into remnants of various size.

Reductions in occupied prairie dog habitat resulted initially from the conversion of native prairies to other uses, primarily relating to farming. Subsequent losses resulted from widespread poisoning programs intended to reduce competition between prairie dogs and domestic livestock for forage, and more recently

from the impacts of sylvatic plague (an Old World disease introduced into North America at the turn of the century). These factors continue to influence prairie dog populations, which in turn influence opportunities for ferret recovery. The only black-footed ferrets known to exist in the wild have resulted from reintroductions using captive-bred stock.

One of the last known populations of ferrets was extirpated in South Dakota

during the early 1970's. The species was feared to be extinct until a small population was found in northwestern Wyoming in 1981. This population was monitored for several years but soon was decimated by disease. Before the ferret population disappeared, a few animals were salvaged for a captive breeding effort conducted by the Wyoming Game and Fish Department, the Fish and Wildlife Service, participating institutions of the American Zoo and Aquarium Association, and other cooperators. Successes in the captive breeding program allowed biologists to initiate reintroduction at a south-central Wyoming site in 1991. Reintroduction efforts in Wyoming were limited by disease and other factors, and the black-footed ferret program in that area was suspended in 1995.

Additional reintroduction efforts began in Montana and South Dakota in 1994 and have continued through 1996. Ferrets released in these States appear to have had higher survival rates than those in Wyoming and have not been impacted by disease to date. Approximately 60 ferrets, including reintroduced captive-born animals and their offspring born in the wild, existed in Montana and South Dakota prior to the release of additional captive-born ferrets in 1996.

Higher ferret survival and productivity rates at the Montana and South Dakota sites are likely associated with the occurrence of more densely populated black-tail prairie dog (*Cynomys ludovicianus*) towns there, as opposed to the white-tailed prairie dog (*Cynomys leucurus*) habitats found at the Wyoming reintroduction site. Improved success also may be the result of "preconditioning" the ferrets in outdoor pens inhabited by prairie dogs.

Prairie dog colonies were integral components of the prairie ecosystem as it once existed across the Plains States.

USFWS photo



... So Goes the Ferret

The plight of the ferret is only part of a greater issue, the loss of a largely unrecognized but perhaps equally important resource—prairie dog towns. Prairie dogs occur on a variety of vegetative communities, and their towns provide food and habitat for many wildlife species. Prairie dogs are consumed by such predators as the coyote (*Canis latrans*), badger (*Taxidea taxus*), swift fox (*Vulpes velox*), golden eagle (*Aquila chrysaetos*), ferruginous hawk (*Buteo regalis*), and red-tailed hawk (*Buteo jamaicensis*). In some locations, even wintering bald eagles (*Haliaeetus leucocephalus*) make their living by robbing hawks that are more successful at catching prairie dogs.

The burrows of prairie dogs are used as shelter and hibernation chambers for many species of snakes, lizards, and amphibians. In portions of the west, burrowing owls (*Speotyto cunicularia*) also depend completely on prairie dog towns, using their holes for nest sites. The associated denuded lands also expose potential enemies and the prey animals on which the owls feed. The burrowing owl is in serious decline throughout many parts of its range in direct response to losses of prairie dog colonies. Like the burrowing owl, the mountain plover (*Eupoda montana*) is also attracted to short grass or barren areas and is closely associated with prairie dog towns throughout much of its range.

Prairie dogs clip tall-growing vegetation within their towns to enhance predator detection. The rather barren appearance of the landscape surrounding prairie dog towns and the associated loss of vegetation have earned prairie dogs the reputation as vermin. Several States still promote their eradication. However, recent information suggests that prairie dogs

are a vital part of the ecology of native grasses, and that burrowing and mixing of soil constituents are important for maintaining the long-term viability of prairie soils.

Among the species associated with prairie dogs that have declined along with the ferret are the ferruginous hawk, burrowing owl, swift fox, and mountain plover. Although the presence of prairie dogs is not compatible with many agricultural uses, there is hope that enough of these animals can be conserved on public lands to ensure the survival and recovery of the black-footed ferret and associated species.

Pete Goher, the FWS Black-footed Ferret Recovery Coordinator, is located in the Pierre, South Dakota, Field Office. Mike Lockhart, also with the ferret recovery program, is in the FWS Laramie, Wyoming, office.

Captive breeding and reintroduction projects are the backbone of the national Black-footed Ferret Recovery Program. Although the program has made substantial strides, the total number of ferrets is still quite small (less than 500).

A black-footed ferret can be a prairie dog's worst nightmare, but recovery efforts for the ferret promote the conservation of prairie dog species and prairie ecosystems by focusing on the common needs of these closely associated mammals.
USFWS photo



by Kim Mitchell and
Cathy Carnes

The Lupine and The Butterfly

*H*abitat loss or modification, the main threat to most rare species, has been particularly hard on the Karner blue butterfly (*Lycaeides melissa samuelis*). Its numbers have fallen by 99 percent in some portions of its range, with most of the losses occurring in the past 15 years. Populations survive only in widely scattered remnants of its former range, which once included 10 northern States and the Province of Ontario. Most of the decline can be traced to the butterfly's dependence on the wild lupine (*Lupinus perennis*) and the ecological changes that are reducing lupine habitat.

The Karner blue is a small (about postage stamp size) butterfly that appears almost white as it flits over short distances. The lower surfaces of the wings of both the male and female are actually slate gray with orange crescents and metallic spots near their margins. The upper wing surfaces of the male are violet blue with a black margin and white fringed edge. The upper surface of the females' wings ranges from dull violet to bright purplish-blue, with marginal orange crescents on the hind wings only.

Ann B. Swengel

Wild lupine is a perennial plant in the pea family with beautiful pink to blue flowers. It is found primarily on dry, sandy soils in open to partially shaded habitats. Many of the areas where the lupine grows are oak savanna and pine barrens plant communities. In addition to the Karner blue, these communities support a diverse

array of other rare plant and animal species such as the Blanding's turtle and prairie fame flower. If the natural forces (e.g., wildfires) that create or maintain these open habitats are suppressed, management is needed. Lupines can occur in power line rights-of-ways and utility corridors, military installations, forest trails, and other open areas that are maintained as early successional landscapes. Without natural or artificial disturbance, savanna and barrens communities yield to shrubs or forests. Lupines in semi-shaded habitats do not flower; lupines in more shaded (or closed canopy) habitats may survive, but usually with poor vigor and without flowering. Eventually, the lupines are shaded out, making the site unsuitable for Karner blues.

The Karner blue butterfly's annual life cycle is inextricably tied to that of the lupine. About mid-April, wild lupines sprout from rhizomes and form clumps of flowering stalks. Two generations of Karner blue butterflies are produced each year. The first brood



begins around mid-April, when eggs laid the previous summer hatch. Tiny larvae crawl up the lupine stems to feed on the new leaves. They eat the interior portion of the leaf, leaving behind the surface layer and creating a "window pane" effect. Dense stands of lupine are necessary to ensure that enough butterflies are produced to maintain the population over time. Peak bloom is reached by mid- to late May, when flowering lupines may create a sea of blue in the open meadows of oak savannas and pine barrens. About the time of peak bloom, the year's first brood of Karner blue larvae pupate. Adults are usually flying from late May through early June.

During the flowering period, the first-flight adult butterflies lay eggs on or near the lupine plants. In about a week, they hatch. The season's second brood of larvae feed through mid-July, when lupine flowering is ending and seed pods are produced. The second-flight adults then emerge through mid-August, depending on weather conditions. Because they cannot depend on lupine flowers for food at that time, the adults must have a variety of mid- to late summer flowering plant species to serve as nectar sources. By the time second-flight females lay their eggs, the lupine is dying back or is already dormant. The active periods for both the plant and the butterfly last only about 4 months of the year (Dirig 1994).

The ranges of the wild lupine and Karner blue do not exactly overlap. Instead, Karner blues are found along the northern extent of the lupine's range. The butterfly occurred historically in a rather narrow band extending from eastern Minnesota across portions of Wisconsin, Illinois, Indiana, Michigan, Ohio, and Canada (Ontario), Pennsylvania, New York, and Massachusetts to New Hampshire. Dirig (1994) surmises that Karner blues are limited to areas where continuous winter snow pack is present for over 80 days. Because the eggs are often deposited on bare sandy

soil, where there is little or no or vegetative litter to protect them, snow is necessary to insulate the eggs from cold temperatures and the drying effects of the sun.

Wild lupine is a plant that thrives in areas that are periodically disturbed, which reduces or eliminates overhead canopies and plant competition. Historically, fire provided open barrens and savanna habitats for colonization by lupine and Karner blues. Not surprisingly, fire suppression has consistently been identified as the primary factor affecting the butterfly's population decline and reduction in range. It is now extirpated from Ohio, Pennsylvania, Massachusetts, Ontario, and probably Illinois, and is barely hanging on in New Hampshire and Minnesota.

The Karner blue fares better today in Wisconsin and Michigan than anywhere else. Landscapes supporting lupines and butterflies in these States vary from public lands managed as savannas or barrens to rights-of-way and military lands. Wildfire, prescribed burns, and artificial disturbance—such as mowing and grazing—have maintained a patchwork of open-canopied and lupine-dominated sites that continue to support Karner blues.

The future for the Karner blue lies in active management to simulate the historic role of fire in maintaining oak savanna and pine barren habitats. The Fish and Wildlife Service looks forward to working with its many partners in the protection of this endangered butterfly, the wild lupine, and the ecosystems upon which both depend.

Dirig, R. 1994. Historical notes on wild lupine and the Karner blue butterfly at the Albany Pine Bush, New York. Pages 23-36 *In* KARNER BLUE BUTTERFLY: a symbol of a vanishing landscape. Edited by D.A. Andou, R. J. Baker, and C.P. Lane. St. Paul, MN Ag. Exp. Stn.

Kim Mitchell and Cathy Carnes are fish and wildlife biologists in the FWS Twin Cities, Minnesota, Regional Office and Green Bay, Wisconsin, Field Office, respectively.



A Karner blue butterfly larva feeds on the young leaves of a wild lupine plant. It is "tended" by ants, which have a mutualistic relationship with the larva. It is thought that the ants provide some protection from larval natural enemies. Larvae, in turn, possess specialized glands that secrete a liquid, thought to be high in carbohydrates and amino acids, avidly harvested by the ants. Larvae tended by ants are thought to be more likely to survive to adulthood.

Ann B. Swengel

Hawaii's Birds and Bees

Botanists estimate that 80 percent of Hawaii's listed plant species are likely pollinated by insects and other animals. But with a few exceptions, the details of pollination for these Hawaiian plants are poorly known or completely lacking. A better understanding of their reproductive biology is needed if recovery efforts are to succeed.

*T*he Hawaiian Islands are home to 277 species of endangered and threatened plants, more than any other State and almost half of all plants listed under the Endangered Species Act. Another 10 Hawaiian plants are considered candidates for future listing. Two basic factors account for these high numbers. As the world's most geographically isolated island ecosystem, Hawaii supports a rich diversity of endemic plants. But these species have been plagued by a variety of impacts, including habitat loss, browsing and trampling by non-native animals, and competition from introduced plants. Another threat, not as well known but of increasing concern, is the decline and extinction of endemic pollinators.

Many endemic plants appear to have evolved closely with avian pollinators. The most notable of these are the lobelias, a number of the hibiscus, and some of the mints. Virtually all of the endemic lobelias bear a flower with a long, curved floral tube, and a number of the native nectar-feeding honeycreepers (forest birds) have long, curved bills that appear to fit these flowers perfectly. While curve- or sickle-billed honeycreepers like the i'iwi (*Vestiaria coccinea*) are still common in many upper elevation habitats, other birds known to be foragers on lobelias, such as mamos (*Drepanis* spp.), are now extinct.

Pollination by insects has not been as well studied in Hawaii, but it probably was a major evolutionary force for many of its native plants. For instance, botanists surmise that two endangered lobelia species, the 'olulu (*Brighamia*

insignis) of the island of Kaua'i and pua 'ala (*B. rockii*) of Maui, Moloka'i, and Lana'i, were pollinated by a species of moth, possibly a hawk moth (Sphingidae). With the apparent extinction of this moth, these plants have been hand-pollinated by researchers of the National Tropical Botanical Garden, located on Kaua'i. The endemic yellow-faced bees (subgenus *Nesoprotopis*), of which some 60 species were originally described, are important pollinators for many of the archipelago's plant species. Among the plants dependent on these bees are such endangered species as the Haleakala silversword (*Argyroxiphium sandwicense* ssp. *macrocephalum*) and 'ohai (*Sesbania tomentosa*). Other native insects that likely serve as pollinators are butterflies, moths, and beetles, but little is known about them.

Just as Hawaii's plants have declined in the face of habitat loss and the effects of introduced species, so have their pollinators. Of the 14 bird species most likely to have played a role in Hawaiian plant pollination, 8 are believed to be extinct and one, the crested honeycreeper (*Palmeria dolei*), is endangered. This leaves only six native bird species that are considered important pollinators. The recent restriction of many of these avian pollinators to habitats above 4,500 feet (likely due to the upper elevational limits of introduced malaria-carrying mosquitos) bodes ill for the native plants that occur only below that elevation. Although there have been introductions of other flower-visiting birds, they certainly will not provide the pollinating services of the original Hawaiian endemics. The continuing decline of some forest bird species will almost certainly have negative impacts on some rare plants as well as on more common species. Hawaii's pollinating insects have undergone declines as well. For example, of the recognized 62 species of native yellow-faced bees originally described from the islands, 37 are considered rare and another 13 are believed to be extinct.

Introductions of alien insects, especially social ants, bees, and wasps in the order Hymenoptera, have had huge impacts on native insect pollinators. Non-native ants are known to prey on the yellow-faced bees and their larvae. This is a well-documented problem in Haleakala National Park and likely occurs elsewhere throughout the islands. In some instances, important nectar resources are monopolized by the European honeybee (*Apis mellifera*), which excludes the native bees and possibly native birds as well. In many of these cases, the introduced bees fail to transfer pollen in a fashion that will result in fertilization and seed set of the plants. Introduced ants, too, will monopolize nectar resources. The big-headed ant (*Pheidole megacephala*) has been observed to drive native yellow-faced bees away from flowers of the endangered 'ohai.

While pollinator extinction has not yet received the attention it needs, some steps have been taken to investigate plant-pollinator associations and initiate recovery efforts. Successful forest bird conservation efforts will likely have positive effects on the native flora. Control of the invasive Argentine ant (*Iridomyrmex humilis*),



The 'i'iwi, a bright vermilion forest bird, has a long, curved bill that fits the curved flowers of Hawaiian lobelias.

Jack Jeffrey



Above:
The 'olulu (*Brighamia insignis*) of Kaua'i is endangered in part due to the presumed extinction of its natural pollinator. The trumpet-shaped flowers will not set seed without being cross-pollinated by botanists using paintbrushes.
Diane Ragone

Right:
***Brighamia* species now survive primarily on remote cliffs that tower thousands of feet above the ocean. Intrepid botanists like Steve Perlman of the National Tropical Botanical Garden rappel down ropes to cross-pollinate the plants by hand. The plants likely lived on flatter ground before introduced ungulates eliminated them from accessible land.**
Ken Wood

which preys on the pollinators of silverswords and other plants, is being researched in Haleakala National Park. (See *Bulletin* Vol. XX No. 4.) This could result in measures that not only protect native pollinators and their associated plant species, but also help protect other native species from ant predation. The Fish and Wildlife Service (FWS) is also supporting research at the University of Hawaii at Manoa to address larval host plant associations of a rare, endemic sphinx moth that is likely important in the pollination of native plants. Issues still to be addressed include control of the introduced

honeybee, which is widespread and common from sea level to high elevation forests.

Naturalist Aldo Leopold spoke of the need to save all "the cogs and wheels" of ecosystems to ensure that they work properly. To be successful in plant and ecosystem conservation, we need to know more about the many integrated parts. The interaction of plants and their pollinators is one of those parts.

Dave Hopper, Adam Asquith, and Marie Brueggemann are biologists in the FWS Pacific Islands Ecoregion Office in Honolulu, Hawaii.



A Lost Piece of the Puzzle

by Sally Valdes-Cogliano

The dodo (*Raphus cuculatus*), a large flightless bird in the pigeon family, has long been considered a symbol of extinction. But the loss of this hapless bird may have had an impact that escaped notice for nearly three centuries.

In the 1970's, botanists noticed that a large tree on Mauritius, *Sideroxylon grandiflorum* (formerly known as *Calvaria major*, and called tambalacoque by Mauritians), was also in danger of extinction. The cause of its decline was uncertain. Most of the remaining trees were greater than 300 years of age. The trees produced seeds but few, if any, were germinating.

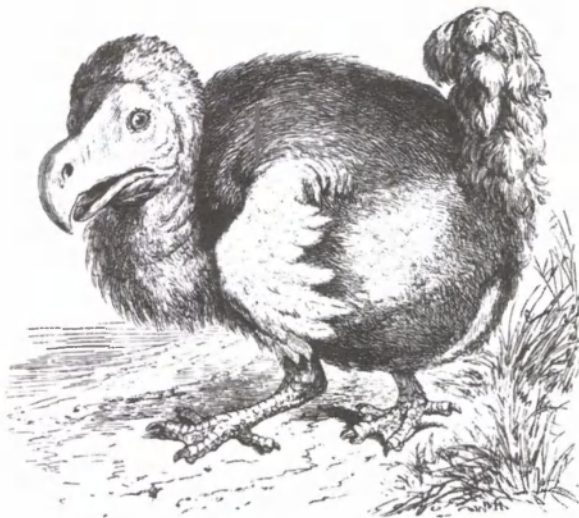
Stanley Temple, a wildlife ecologist at the University of Wisconsin, suggested that there could be a connection between the loss of the dodo and the decline of the tambalacoque tree. Before the dodo became extinct, its diet included the fruit and seeds of trees. Temple hypothesized that the tough seeds of the tambalacoque may have been an adaptation to resist crushing in a dodo's gizzard. The trouble is that such an adaptation could result in a pit too thick to germinate without abrasion of its outer wall. To test his idea, Temple fed tambalacoque seeds to domestic turkeys. Some of the pits that passed through the turkeys were crushed, but most survived after considerable abrasion of the outer hull. Temple then planted the seeds, and 30 percent germinated.

Because the dodo is extinct, Temple's hypothesis that dodos and tambalacoque trees had a mutualistic relationship cannot be tested directly. But it did offer a possible explanation

for what was an extraordinarily poor seed germination rate for tambalacoque trees. The good news is that the tambalacoque is no longer in danger of extinction. The Mauritius Forestry Service now promotes the survival of this tree by abrading its seeds and has achieved good germination success. This time, the loss of another piece of nature's puzzle has been averted.

Sally Valdes-Cogliano is a biologist with the Fish and Wildlife Service's Division of Habitat Conservation in Washington, D.C.

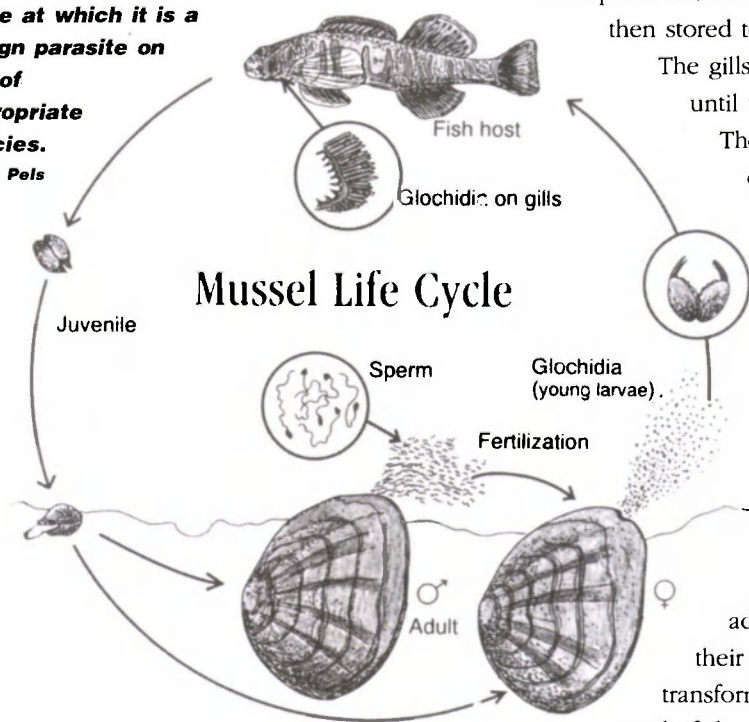
Endemic to Mauritius, an island in the Indian Ocean off eastern Africa, the dodo was discovered by Portuguese explorers in 1505. Within 200 years, the species had disappeared. No living dodos have been seen since 1681. Passing sailors found the bird easy to kill and hunted it heavily for fresh meat and eggs. Pigs and other non-native mammals introduced to the island may also have contributed to its loss.



The Mussel/Fish Connection

*F*reshwater mussels, the most endangered family of animals in the United States, have a reproductive cycle unique to the animal world. Most marine mussels reproduce by spawning their free-floating gametes into the water column, where fertilization and larval development occur before the juvenile mussels settle to the bottom. But the native freshwater mussels of our river systems have developed an unusual reproductive strategy. It allows them to disperse upstream and to take advantage of the nutrition provided by freshwater fish.

The life cycle of most freshwater mussels includes a brief but vital stage at which it is a benign parasite on fish of appropriate species.
Emily Pels



The reproductive cycle of mussels usually begins with male mussels releasing sperm into the water in spring or summer. The female draws the sperm in through her siphon and her eggs are fertilized internally. These fertilized eggs are then stored temporarily in her gills, which serve as brood pouches.

The gills are capable of holding up to several million embryos until they develop into larvae (glochidia) in about 2-3 weeks.

These glochidia are less than 0.01 inch (0.25 millimeter) in diameter and have gaping, half-moon shaped valves or shells with a single muscle to open and close them.

When the glochidia have developed, the female releases them into the water, where they drift helplessly downstream unless they contact a fish. If glochidia attach to a fish of the appropriate species, either on the gills (for most mussel species) or fins, they become encapsulated by the fish and draw sustenance from its blood. This brief parasitic phase, which lasts only a few weeks, provides an opportunity for mussel larvae to reach other areas. Dispersal in an upstream direction is possible only at this stage, as adult mussels are sedentary and move very little during their 20-50 year life span. Once the larvae have completely transformed into young mussels, they drop from the fish carrier and, if they fall onto the appropriate substrate for that species, begin their growth to adulthood. The fish swims away unharmed.

Because the contact of a mussel with its host fish is a hit-or-miss event, females of some mussel species have developed ingenious mechanisms to lure fish in and improve the chances. These include such adaptations as body structures that mimic

the appearance of a fish's mate or a prey species, and releasing glochidia in "packets" that resemble edible larval fish or colored worms (see "Fishing Mussels" in *Bulletin*, Vol. XXI No. 2). However, the suitability of fishes to host glochidia is not universal; the larvae of certain mussel species can survive only on certain fish species. Thus, the luring behavior of female mussels must be specific to target fishes. Recent laboratory studies have shown that female mussels can sense the presence of host fish by chemical cues.

Why do some fish serve as hosts but others do not? Can the mussel larvae tell the difference between a black bass and a black crappie? Laboratory research indicates that the recognition, or lack thereof, is on the part of the fish and not the mussel larvae. Apparently, the immune system of non-host fish species attacks the glochidia as foreign invaders and promotes the sloughing of these would be hitch-hikers. Conversely, the immune system of host fish species does not exhibit instant rejection of these benign parasites; the fish merely encapsulates them in tissue, walling them off to prevent any potential harm. However, even host fish, upon re-infestation, will exhibit a low-level immune response and attack the glochidia as aliens. Thus, host fish can "learn" to recognize glochidia as tiny parasites and attempt to rid themselves of these freeloaders.

In recent years, the reproductive success of native mussels has taken a turn for the worse. Populations of many species consist of old individuals that have not reproduced in more than a decade. What is the impasse in their reproductive cycle? Some researchers have suggested that the host fishes have disappeared, leaving the released glochidia to float downstream to a certain death. However, research indicates that hosts frequently are present but probably in lower numbers than before. Our native fish fauna has been drastically altered by habitat degradation, water pollution, introduction of non-indigenous species, and other factors that have altered species composition and abundance. It is likely, therefore, that attachment to host fishes may not be occurring at levels sufficient to maintain the mussel populations that are in decline. This gradual decrease in host fish abundance could account for the steady decline being reported in many endangered mussel species throughout the country.

If we knew the identity of the host fishes for endangered mussel species, we could sample the fish populations and assess whether mussel reproduction is being hampered by a reduced diversity and abundance of their hosts. Unfortunately, we know the hosts for only one-third of all mussel species and less than one-fourth of the species that are listed federally as endangered. Our ability to determine whether host fishes are the reproductive bottleneck for these species is hampered by our lack of information. Similarly, without knowledge of host fishes, no mussel propagation efforts are possible in a laboratory or hatchery setting. Host fishes are truly critical to recovery of the 57 mussel species recognized as endangered or threatened in the United States.

Some mussels lure potential hosts with body structures that mimic other fish.

Richard J. Neves



Dr. Neves is Leader of the Virginia Cooperative Fish and Wildlife Research Unit at Virginia Polytechnic Institute and State University in Blacksburg.

Pelican Deaths Linked to Sick Fish

An outbreak of avian botulism that by October 31, 1996, had killed at least 1,125 endangered brown pelicans (*Pelecanus occidentalis*), 8,525 American white pelicans (*Pelecanus erythrorhynchos*), and 4,383 other birds in southern California's Salton Sea may indicate a larger environmental problem. Two biological laboratories of the U.S. Geological Survey have reached a preliminary conclusion that the bird deaths may be traceable to massive kills of tilapia, an African fish species introduced into the Salton Sea.

Biologists attempt to rehabilitate one of the sick pelicans at Salton Sea National Wildlife Refuge's "pelican hospital."

Ken Sturm/USFWS



The U.S. Fish and Wildlife Service (FWS), California Department of Fish and Game, and the laboratories in the Biological Resources Division of the Geological Survey have worked together for two months to respond to the botulism outbreak and determine its cause. Avian botulism, which is caused by a toxin produced by the anaerobic bacterium *Clostridium botulinum*, is considered a disease of waterfowl. It has never before been reported to affect pelicans in such large numbers.

The Geological Survey's Northwest Biological Science Center in Seattle, Washington, reports that all of the Salton Sea fish samples examined had acute bacterial infections. The type of bacterium responsible for the fish infections and deaths is *Vibrio alginolyticus*. This microbe is known to inhabit salt water and has been previously associated with disease in fish.

Although the link between bacterial infection in tilapia and botulism poisoning in birds is not proven, scientists suspect the bacterial disease may produce conditions in the intestinal tract of sick fish that allow botulism spores to germinate and produce toxin. The spores themselves are likely to be widely present in both the Salton Sea and the fish. The dying fish become easy prey for pelicans, herons, and other fish-eating birds that then ingest fatal doses of toxin.

Scientists from the Geological Survey's National Wildlife Health Center in Madison, Wisconsin, will be conducting additional studies to determine if and how botulism toxin is actually produced in the sick fish.

Outbreaks of fish diseases are often triggered and sustained by environmental stresses, including pollution, overcrowding, and high temperatures or salt levels. All of these factors are present in the Salton Sea. The Northwest Biological Science Center plans to continue monitoring Salton Sea fish to determine if the *Vibrio* outbreak is a one-time event or a chronic problem.

As of October 14, 1996, 1,121 brown pelicans and 8,369 white pelicans had died from avian botulism. An additional 4,078 birds of 59 other species also died. In addition, 814 brown pelicans and 183 white pelicans were sent to a rehabilitator for treatment. Release of rehabilitated pelicans began on September 19. As of October 14, 167 brown pelicans and 62 white pelicans had been released at Seal Beach National Wildlife Refuge on the California coast.

State and FWS employees have been systematically removing dead and dying birds from the Salton Sea each day since August 15 because carcasses provide a nutrient medium for the spread of botulism.

The Salton Sea was formed in 1905 when the Colorado River burst out of an irrigation canal and flooded the dry alkaline basin of the Imperial Valley. Water flowed for the next 2 years until the flooding could be stopped. Today, the Salton Sea is kept full by irrigation run-off from surrounding farm lands and precipitation flowing down from the mountains. The Salton Sea is the largest inland body of water west of the Rockies, about 35 miles (56 kilometers) long and 9 to 15 miles (14 to 24 km) wide. At 227 feet (70 meters) below sea level, it also is one of the lowest and warmest spots in the United States.

The Salton Sea's strategic position on the Pacific Flyway attracts thousands of birds to the open waters and the marshes on its edges. It is a notable migration stopover or wintering area for many species, and a portion was designated as a national wildlife refuge in 1930.

Susan Saul is a Public Affairs Specialist with the FWS Portland, Oregon, Regional Office.



Some of the sick brown pelicans under care at the Salton Sea refuge.
Ken Sturm/USFWS

Condors Return to Arizona

A giant step in the recovery of the California condor (*Gymnogyps californianus*), one of the world's largest and rarest flying birds, took place October 29, 1996, when 6 captive-reared condor chicks were transferred to a release site located in the vast canyonlands of northern Arizona. The Fish and Wildlife Service (FWS), in cooperation with the Bureau of Land Management and the Arizona Game and Fish Department, plans to release the chicks at the Vermilion Cliffs, about 30 miles (48 kilometers) north of Grand Canyon National Park on the southwestern corner of the Paria Plateau, in early December 1996.

Robert Mesta and Dianna Van Safford (FWS Phoenix, Arizona, Field Office) escort the young condors to their new home in northern Arizona.

Philip W. Carroll

This large and remote area, which supported California condors in historical times, contains the ridges and cliffs needed by this soaring bird and caves for nesting. As the young condors mature and expand their range, they

are expected to move east along the Vermilion Cliffs to Marble Canyon, where they will likely fly north to Glen Canyon or south to the Grand Canyon. The area that condors may eventually occupy stretches from eastern Utah southwest through northern Arizona to southern Nevada, providing the species with ample habitat in which to raise future generations. If the reintroduction project is successful, it will achieve one of the primary goals of the California Condor Recovery Plan: to establish a second self-sustaining population in the wild. The existing wild population is in southern California, where biologists are releasing captive-bred condors into the region from which the last condor of the original wild population was collected in 1987.

Current plans call for a long-term effort to release a cohort of captive-reared California condors at the Vermilion Cliffs each fall. The condors will be raised at the breeding facilities by their parents or by handlers using condor



look-alike hand puppets to avoid imprinting the chicks on humans. At the age of 3 to 4 months, the young birds will be transported to a pen at the release site to promote social bonding and undergo aversion training to make them avoid power lines. Collisions with power lines have caused the death of four condors and imperiled the lives of others. When the condors are about 6 months old, biologists will release them into the wild. Once released, the birds will be monitored through the use of radio transmitters and wing markers. Biologists will provide carrion for the released condors until the birds learn to locate carcasses on their own.

The experimental Vermilion Cliffs release project is a cooperative effort by the FWS and its primary cooperators, the Arizona Game and Fish Department and the Bureau of Land Management. Other cooperators include Grand Canyon National Park, Glen Canyon National Recreation Area, Kaibab National Forest, the Hualapai Tribe, the Navajo Nation, the Los Angeles Zoo, San Diego Wild Animal Park, and the Phoenix Zoo. The Peregrine Fund, which maintains one of the three condor breeding facilities, has been contracted to carry out the release program in the field.

Under section 10(j) of the Endangered Species Act (ESA), California condors released into northern Arizona will be designated as a "nonessential experimental" population. Such a designation means the condors will be treated under the ESA as a threatened population for section 9 purposes (protection from take). For the purposes of section 7 (interagency consultation), the birds will be treated as a species *proposed* for listing—except on National Park System and National Wildlife Refuge System lands, where they will be treated as if threatened.

The "nonessential experimental" designation enables the FWS to develop special management regulations that are more flexible than the rules

applying to species classified as endangered. This flexibility helps to ensure that such land uses as forest management, agriculture, mining, livestock grazing, sport hunting, and non-consumptive outdoor recreation in the area will not be restricted. Further, designation of the population as nonessential and experimental will encourage cooperation in this recovery effort by landowners, agencies, and recreational interests in the area. The proposal to reintroduce condors in the Vermilion Cliffs area as an experimental population appeared in the January 2, 1996, *Federal Register*. After notices were published in local newspapers, the FWS held 59 meetings (including 2 public hearings) in the vicinity to further explain the proposal and gather public comments.

Young condors for the northern Arizona reintroduction effort will come from the three captive-breeding flocks. At present, 104 California condors are being maintained for propagation at the Los Angeles Zoo, San Diego Wild Animal Park, and World Center for Birds of Prey, a Peregrine Fund facility in Boise, Idaho. Another 17 condors are flying free in California, where a separate reintroduction project has been progressing since 1992.

The California condor was last seen in Arizona in 1924, but thanks to the spirit of cooperation shown thus far in the recovery effort, this magnificent bird will soon grace the skies of Arizona once again. When the first condor soars from the Vermilion Cliffs this December, so too will hope for the recovery of this endangered species.

Robert Mesta, the FWS California Condor Program Coordinator, is in the Ventura, California, Field Office.



Tagged immature condor in California

David Clendenen/USFWS

Upon release into the wild, condors raised in propagation facilities sometimes show behavior threatening to their survival. In a sense, they no longer know how to act as wild animals. The greatest threats these birds face in the environment are people and their structures—specifically, power lines and poles. Early in 1995, a program to teach condors to avoid power poles was initiated at the Los Angeles Zoo. Power pole aversion training was accomplished by constructing an electrified mock power pole in the large flight pen holding young condors scheduled for release to the wild. This pole was designed to give the condors that landed on it a mild but uncomfortable electrical shock. Natural tree snags were placed in the flight pen to reward the condors that perched on them with a positive experience—no shock. To date, the aversion training appears to be a big success.

A Wish Takes Wing

*H*e could have asked for anything, this young man from Fullerton fighting to overcome a rare form of cancer. But instead of opting for a trip to Disneyland or a meeting with his favorite movie star when the Make-A-Wish Foundation offered to fulfill a dream for him, 18-year-old Sean Morrissey wanted to see a California condor, the bird fighting its way back from near extinction.

Editor's note: On October 9, the Los Angeles Times published a story, excerpted at right, about a special young man and his wish to see a California condor. The Fish and Wildlife Service was pleased to help make that wish come true.

On Tuesday (October 8), in a stuffy, sweat-inducing bird blind, deep in the rugged mountains behind Fillmore, he got his wish—eight times over.

There they were, the eight juvenile California condors, ranging in age from 4 1/2 to 6 months. Oblivious to Morrissey's rapt stare and quiet demeanor, they squatted balefully on tree stumps, stalked around their pens and even, during one breath-catching moment, showed off their legendary nine-foot wing span. Accompanied by his three younger sisters, his parents and his aunt, Morrissey spent the day at the U.S. Fish and Wildlife Service's Hopper Mountain National Wildlife Refuge, where young condors are taken to test their wings and learn to fly before being released into the wild.

The visit, which coincided with National Wildlife Refuge Week, had been planned since June. Morrissey's parents contacted the Make-A-Wish Foundation after their son's condition was diagnosed as soft cell sarcoma, an extremely rare form of cancer.

The foundation grants wishes to children ages 2 1/2 to 18 with life-threatening illnesses. Morrissey had trouble with his left foot since he was seven. But his father, Nick, said repeated trips to doctors over the years never yielded answers.

No one knows for sure when the lump in his foot turned cancerous. But by the time doctors finally identified the problem, they told his family they had to amputate his leg or he probably would die within a year.

Now, with a few more sessions of chemotherapy to go and the kind of quiet determination that fueled him up and down a steep path to the condor's pens Tuesday—despite a new prosthetic leg—Morrissey has another chance at life. It's only fitting then, said his aunt, that he would want to meet the condors. "After what he's been through, losing his leg, now he has a second chance at life," Nancy Morrissey said. "And the condors, they were taken out of the wild and now this is their second chance. Both of them wanted freedom and another chance, and they're both getting it."

Nancy Morrissey played a key role in developing her nephew's interest in birds. A longtime Fish and Wildlife employee, she is the assistant refuge manager for western Oregon. Sean Morrissey learned to love birds on trips to visit her, and the condors particularly attracted his curiosity. In eighth grade, he wrote a three-page essay about the species at a time when the California Condor Recovery Program was just beginning to reintroduce the birds into

the wild after successfully raising chicks in captivity. Over the next few months, the eight birds Morrissey saw Tuesday will be released after being trained to avoid humans.

Few people are ever allowed to visit the Hopper Mountain refuge, which lies at the end of a bumpy, dirt road dotted with oil wells, hairpin curves and spectacular vistas. Its isolation gives the condor recovery program much-needed seclusion. Condors are by nature curious, and after previous releases close to civilization, they have been killed by eating anti-freeze and landing on power lines.

As a result, the birds are no longer released in Ventura County. Instead, biologists set them free farther north in Los Padres National Forest in Santa Barbara and San Luis Obispo counties.

Today, the Morrissey family will travel into that wild territory, hoping for a look at free-flying condors. Because biologists can't guarantee a sight of those condors, they opted to bring the family first to the Hopper Mountain refuge.

But even the sight of the birds inside their rearing facility seemed enough for Sean Morrissey. After watching one of

the younger birds climb the side of its cage, throw open its wings and experiment with the concept of flapping, Sean Morrissey said his wish fulfillment was already better than he expected.

"That was impressive," he said, a slight smile lighting his solemn features.

Mary Pols is a staff writer for the Los Angeles Times. This article is copyrighted by the Times and reprinted with permission.

* * *

When Sean Morrissey and his family later visited the Lion Canyon release site in an attempt to see a wild condor, they were rewarded with the spectacle of six condors soaring overhead. Refuge staff described him as 'ecstatic.'



Sean Morrissey and his aunt, Assistant Refuge Manager for western Oregon, coming back from the condor rearing facility at Hopper Mountain National Wildlife Refuge.
David Clendenen/USFWS

The Conasauga Saga

Imagine a sparkling mountain stream where abundant and colorful fishes dart about, and the rocky bottom is paved with beds of freshwater mussels. Several of these aquatic organisms—with interesting names like the frecklebelly madtom (*Noturus munitus*), burrhead shiner (*Notropis asperifrons*), Tennessee heelsplitter (*Lasmigona holstonia*), and upland combshell (*Epioblasma metastriata*)—are found nowhere else on earth. Such a picture reflected much of the Conasauga River's 91-mile (146-kilometer) length a mere 80 years ago.

Outreach is an important part of the conservation effort. The FWS field office in Jackson, Mississippi, has worked with the Tennessee Aquarium in nearby Chattanooga and with the Institute of Ecology to produce an educational pamphlet about the values provided by a healthy river system. In addition, the U.S. Department of Agriculture's Natural Resources Conservation Service is working through the Limestone Valley Resource Conservation and Development Council to contact landowners, business leaders, and other interested parties in the area for their ideas about ways to better manage the watershed.

Originating in the Blue Ridge Mountains of north Georgia, the Conasauga River flows northwestward into southeastern Tennessee before dipping back south into Georgia. Comprising the headwaters of the Coosa River system in the species-rich Mobile River Basin, the Conasauga now contains a paltry fraction of the biological diversity it supported before the turn of the century. Much of the lower river system has been degraded by pollutants from industry and sedimentation from poor land-use practices. More than two dozen mussel species and several fishes have disappeared from its waters. Sadly, at least seven species of mussels that once occurred there are now considered extinct throughout their *entire* range.

All is not lost, however. The headwaters of the Conasauga from the vicinity of the Georgia/Tennessee State line upstream still flows clear and is relatively pristine. Seven federally listed species, all endemic to the Mobile River Basin, still call this river home. Three of them are fishes:

the endangered amber darter (*Percina antesella*) and Conasauga logperch (*Percina jenkinsi*) and the threatened blue shiner (*Cyprinella caerulea*). Four mussels—the endangered Coosa moccasinshell (*Medionidus parvulus*), southern pigtoe (*Pleurobema georgianum*), and triangular kidneyshell (*Ptychobranchnus greeni*) and the threatened finelined pocketbook (*Lampsilis altilis*)—round out the seven listed species. In addition, about a dozen more rare species inhabit its waters. The river also provides designated critical habitat for the Conasauga logperch, which is found only in the Conasauga River, and the amber darter.

Helping to preserve this exceptional example of a southeastern riverine ecosystem is a veritable army of researchers, resource managers, and interested individuals with various government agencies and private organizations. The U.S. Fish and Wildlife Service's (FWS) field offices in Jacksonville, Florida, and Asheville, North Carolina, have provided funds

to The Nature Conservancy to begin restoration work along the upper river corridor. Conservancy field offices in Tennessee and Georgia are working to identify areas with high biological diversity, map land-use patterns within those areas, and pinpoint threats to habitat quality. The U.S. Forest Service, which manages two national forests in the Conasauga headwaters (the Chattahoochee National Forest in Georgia and Cherokee National Forest in Tennessee), is monitoring rare fishes and has an interest in the well-being of other species at risk. Researchers at the University of Georgia's Institute of Ecology are mapping quality habitats and conducting studies on the status and life history of federally listed species, with financial support from the Endangered Species Act's section 6 program and the States of Tennessee and Georgia.

Significant benefits have already been achieved from similar efforts by The Nature Conservancy on the Clinch River, a stream in the upper Tennessee River system that also is rich in biological diversity. Partnerships with willing landowners have eliminated major sources of sedimentation and nutrients from the system, and have restored riparian areas that filter pollutants and provide habitat for neotropical migratory birds. In return, landowners benefit from the control of erosion and sloughing of their stream banks and adjacent land.

With the continued efforts of the agencies, organizations, and individuals involved in the Conasauga River project, one more of America's imperiled riverine ecosystems may be saved for posterity.

Robert S. Butler, Riparian Lands Restoration Biologist, and Richard G. Biggins, Fish and Mollusk Recovery Coordinator, work in the FWS Asheville, North Carolina, Office.



Biologists seine the Conasauga River to assess populations of the blue shiner and other endangered fishes.

Richard G. Biggins

True to its name, the blue shiner, a medium sized minnow attaining a length of about 4 inches (10 centimeters), is dusky blue in color with yellow fins.

Richard G. Biggins





Region 1

Ute Ladies'-tresses (*Spiranthes diluvialis*) A population of this orchid species, listed as threatened in January 1992, was discovered recently along the south fork of the Snake River downstream of the Palisades Dam in Idaho. The plants are on Federal lands administered by the Forest Service and the Bureau of Land Management. The discovery of Ute ladies'-tresses in Idaho represents a significant range extension. Other populations of this orchid occur in Utah, Colorado, Wyoming, Montana, and Nebraska. Although no populations have been identified on private lands in Idaho, the species may occur in areas containing suitable riparian or wet meadow habitat. The FWS will seek voluntary cooperation from private landowners whose property may support the orchid.



Ute ladies'-tresses
(*Spiranthes diluvialis*)

Bob Moseley, a plant ecologist, and Mabel Jones, a wetland ecologist at the Idaho Conservation Data Center, discovered the Idaho population during surveys conducted as part of the FWS recovery effort for this species. The draft recovery plan calls for surveys to be conducted on public lands where potential habitat may be found.

This species may be adversely affected by modification of riparian habitat, including stream channelization, urban development, and construction projects. It is likely that current recreational activities such as boating can continue without adversely affecting the habitat.

The FWS will look for opportunities to use Partners for Wildlife Program funding to implement watershed improvement projects with willing cooperators. FWS biologists have already met with the Bureau of Reclamation to discuss the Snake River flow levels needed to maintain a stable population of this plant.

Green Sea Turtle (*Chelonia mydas*) In a cooperative effort, researchers at the Cornell University School of Veterinary Medicine, the National Wildlife Health Center's (NWHC) Honolulu Field Station, and the Marine Turtle Research Program of the National Marine Fisheries Service (NMFS) have discovered the presence of a new retrovirus in green sea turtles affected with fibropapillomas. Fibropapillomatosis is a serious disease of this listed species in Hawaii, Florida, and other parts of the world. (See *Bulletin* Vol. XXI No. 2.) It causes large skin tumors, particularly around the limbs, eyes, and mouth. These tumors impede effective foraging by the affected turtle and can lead to eventual starvation. The prevalence of this disease is increasing and poses considerable risk to free-ranging green sea turtle populations.

George Balazs of NMFS has been cooperating with Thierry Work of the NWHC in conducting necropsy surveys of turtles washing up moribund or dead in Hawaii. The research team from Cornell—including James and Rufina Casey, Paul Bowser, and Sandra Quackenbush—subsequently lent their expertise in molecular biology of fish retroviruses to ferret out retroviruses from the turtle tumors.

The discovery of retroviruses in turtle tumors raises the possibility that such a virus is responsible for the tumors. To date, the only other pathogen found with these tumors is a herpes virus discovered by researchers at the University of Florida in Gainesville. Whether either a herpes virus or retrovirus is responsible for the tumors remains a mystery. The NWHC central laboratory in Madison, Wisconsin, has successfully established laboratory cell cultures from green sea turtle embryos provided by the FWS and a private organization (Sea Life Park, Hawaii). The researchers will cooperate to further clarify the role that retroviruses may play in green sea turtle fibropapillomatosis.

Region 2

Attwater's Greater Prairie-chicken (*Tympanuchus cupido attwateri*) In the spring of 1996, only an estimated 42 individuals of this endangered bird remained in the wild at 3 areas in eastern Texas. These wild populations received a much-needed boost in July and August through the release of 50 captive-reared birds on the Attwater Prairie Chicken National Wildlife Refuge and 19 birds on The Nature Conservancy's Galveston County Coastal Prairie Preserve. All of the birds were fitted with radio transmitters to facilitate monitoring after their release. By the end of October, 67 percent of the released birds survived. All but three of the birds that died were lost to predation.

The released birds had been hatched and reared at the Houston Zoological Gardens and Fossil Rim Wildlife Center. Texas A&M University-College Station and the San Antonio Zoological Gardens and Aquarium also hold Attwater's prairie-chickens for propagation.

Mexican Gray Wolf (*Canis lupus baileyi*) The captive Mexican wolf population stands at 150 animals after this year's breeding season. Eleven pups were born to pairs at Wolf Haven in Tenino, Washington (4), the Phoenix Zoo in Arizona (3), and the Rio Grande Zoo in Albuquerque, New Mexico (4). Another four pups were produced to pairs at two cooperating facilities in Mexico.

Mexican wolves are being managed for the recovery program by 24 cooperating facilities in the U.S. and 5



Mexican gray wolf
USFWS photo

in Mexico. A new breeding facility on Sevilleta National Wildlife Refuge in New Mexico is receiving its first wolves in November. These animals may be selected for the first Mexican wolf reintroduction effort if the Fish and Wildlife Service's (FWS) proposal to restore a "nonessential, experimental" population in New Mexico and Arizona is approved. (See *Bulletin* Vol. XX No. 5.) A final environmental impact statement on the proposal is expected to be released soon.

Region 3

Fat Pocketbook Pearlmussel (*Potamilus capax*)

Funded with an ESA section 6 grant to the Missouri Department of Conservation, Dr. Chris Barnhart of Southwest Missouri State University has identified for the first time one of the suitable fish hosts for this endangered mussel. During its parasitic larval stage, approximately 200 juvenile fat pocketbook pearlmussels successfully matured on the freshwater drum (*Aplodinotus grunniens*). The drum had been suspected as a potential host in the past, but was never confirmed. During the research, Dr. Barnhart and the Neosho National Fish Hatchery are attempting to rear the juvenile mussels to the stage that they can be reintroduced to the wild.

Eastern Prairie Fringed Orchid (*Platanthera leucophaea*)

In recent times, some populations of this threatened wildflower in northeastern Illinois have had reproductive problems, possibly because of inadequate pollination. To aid in its recovery, botanists have hand-pollinated plants and dispersed their seeds. Although the results are not yet known, we have seen one positive outcome: after involvement with this restora-

tion project, a private property owner dedicated the portion of his property containing the orchid as an Illinois State Nature Preserve. He has also worked with volunteers to manage orchid habitat on his property.

Indiana Bat (*Myotis sodalis*) The Indiana Department of Natural Resources and the FWS have cooperatively funded a project to assist in recovery of the endangered Indiana bat. The 3D/International Environmental Group, with support from the Indianapolis International Airport and the Texas Gas Corporation, completed a literature summary and Habitat Suitability Index model for components of Indiana bat summer habitat. The model will be useful in quantifying summer roosting and foraging areas lost to development, planning habitat restoration, and managing existing habitat. It has been applied successfully to evaluate habitat conditions on commercial development sites, Federal lands, and a Superfund site.

Kirtland's Warbler (*Dendroica kirtlandii*)

The 1996 census of singing males resulted in the second-highest number for this endangered species since the annual counts began in 1951. During the June survey, researchers, biologists, and volunteers counted 692 singing males in Michigan, including 14 in the Upper Peninsula. The record high of 765 was established in 1995, compared to the record low count of 167 in 1987. Especially encouraging is the fact that the Upper Peninsula count is the highest ever recorded there. The presence of at least six females and the mist netting of two juvenile birds in the Upper Peninsula indicates successful nesting activity. This is only the second year that mated pairs have been found outside of the traditional nesting areas in the northern Lower Peninsula. One singing male was also reported in Wisconsin.

Piping Plover (*Charadrius melodus*)

Studies of the critically endangered Great Lakes population of the piping plover continued over the summer. During the 1996 nesting season, 23 nesting pairs produced about 89 eggs and fledged 28 to 30 young. Nest protection and a landowner outreach program complement the habitat use and productivity studies.

Region 5

Endangered Bats The FWS West Virginia Field Office has assisted in the construction of gates at all five known entrances to the Arbogast/Cave Hollow Cave system, located on the Monongahela National Forest in Tucker County, West Virginia. These gates are intended to protect the habitat of endangered bats from human disturbance. The Arbogast/Cave Hollow system supports a large winter and summer colony of Virginia big-eared bats (*Plecotus townsendii virginianus*) and a winter colony of Indiana bats (*Myotis sodalis*). Partners in the gating work included the Monongahela National Forest, West Virginia Department of Natural Resources, Natural Resource Conservation Service, National Speleological Society, American Cave Conservation Association, and The Nature Conservancy.

Dwarf Wedge Mussel (*Alasmodonta heterodon*)

Last year, during a statewide survey of freshwater mussels in New Hampshire, two previously unknown sites for this endangered mussel species were discovered in the mainstem of the Connecticut River, which forms the boundary between New Hampshire and Vermont. Two live dwarf wedge mussels were found in the upper Connecticut River near Dalton, New Hampshire, and shells were found near Lancaster, New Hampshire.

After these discoveries were made, two bank stabilization projects on the Vermont side of the Connecticut River were proposed for construction in the general vicinity of the new mussel sites. To assess the potential impacts of these projects on the species, biologists from the FWS New England Field Office and divers from the Vermont Agency of Transportation and Vermont Department of Environmental Conservation, volunteers from The Nature Conservancy, and a private individual have explored a stretch of the river. Survey results indicate that a large, scattered population of dwarf wedge mussels extends along the 8-mile (13-kilometer) stretch surveyed and probably further upstream and downstream as well. The mussels were found on sand bars and clay banks, unusual locations for this species in New England, as well as on the more typical sand/pebble/cobble substrate.

Final Listing Rules

During October 1996, the Fish and Wildlife Service (FWS) published final rules in the *Federal Register* listing 84 plants as endangered or threatened. Endangered Species Act (ESA) protection has been extended to the following:

Seventy-five Hawaiian Plants On October 10, the FWS published 6 separate rules listing a total of 75 plant taxa endemic to the Hawaiian Islands. These plants have declined significantly in population and distribution, and some now number fewer than 10 surviving individuals. They face a multitude of threats, including competition from introduced plant species; habitat destruction by feral or domestic non-native animals; predation by rats, insects, and other introduced animals; fire; and agricultural, military, and urban development. The Hawaiian names, if any, follow the scientific names as listed below.

In one rule, the FWS listed as endangered *Delissea undulata*, a palm-like tree in the bellflower family

(Campanulaceae) now found only on the island of Hawai'i. Only a single plant remains in the wild, growing on the edge of a collapsed lava tube.

One rule classified 13 plant species endemic to the island of Hawai'i as endangered:

Clermontia drepanomorpha, or 'oha wai—a tree in the bellflower family with purplish-black flowers;

Cyanea platyphylla, or haha—a palm-like shrub in the bellflower family with white and magenta-striped flowers;

Hibiscadelphus giffardianus, or hau kuahiwi—a tree in the mallow family (Malvaceae) that is extinct in the wild but survives in cultivation;

Hibiscadelphus hualalaiensis, or hau kuahiwi—another tree that is extinct in the wild;

Melicope zahlbruckneri, or alani—a tree in the citrus family (Rutaceae) known from a single fenced population of 35 plants;

Neraudia ovata—a shrub in the nettle family (Urticaceae) with 11 individuals remaining in the wild;

Phyllostegia racemosa, or kiponapona—a climbing, white-flowered vine in the mint family (Lamiaceae);

Phyllostegia velutina—a vine in the mint family;

Phyllostegia warsbaueri—a vine in the mint family with white and rose-colored flowers, known from only 10 individuals;

Pleomele hawaiiensis, or hala pepe—a tree in the agave family (Agavaceae) that grows on open lava fields;

Pritchardia schattaueri, or loulou—a large palm in the family Arecaceae, known from only 12 wild individuals;

Sicyos alba, or 'anunu—a white-flowered vine in the gourd family (Cucurbitaceae), known from only two populations; and

Zanthoxylum dipetalum var. *tomentosum*, or a'e—a tree in the citrus family, known from 1 population of 24 plants.

Another rule listed 19 plant species endemic to the island of Kaua'i for ESA protection. Seventeen were listed as endangered:

Alsinidendron lynchnoides, or kawawaenohu—a white-flowered subshrub in the pink family (Caryophyllaceae);

Alsinidendron viscosum—a recently-discovered subshrub in the pink family, named for the sticky hairs that cover the entire plant;

Cyanea remyi, or haha—a purple-flowered shrub in the bellflower family, rediscovered recently after not being seen for more than 130 years;

Cyrtandra cyaneoides, or mapele—a shrub in the African violet family (Gesneriaceae) with shaggy brown hairs on the flowers and berries;

Delissea rivularis, or 'oha—a shrub in the bellflower family known from a single population of 20 plants;

Hibiscadelphus woodii, or hau kuahiwi—a small, cliff-side dwelling tree in the mallow family, discovered by its namesake, Ken Wood, and known from just four trees;

Hibiscus waimeae ssp. *banneriae*, or koki'o ke'oke'o—a tree in the mallow family with large white flowers that fade to pink in the afternoon;

Kokia kauaiensis, or koki'o—a tree in the mallow family;

Labordia tinifolia var. *wahiawaensis*, or kamakahala—a shrub or small tree in the family Loganiaceae, decimated by Hurricane Iniki in 1992;

Phyllostegia knudsenii—a recently rediscovered perennial herb or vine in the mint family with only one wild individual;

Phyllostegia waurana—a perennial vine in the mint family, rediscovered in 1993;

Pritchardia napaliensis, or loulou—a small palm named for the rugged Na Pali Coast of Kaua'i;

Pritchardia viscosa, or loulou—a taller species of palm, known from one population of three individuals;

Schiedea belleri—a recently rediscovered vine in the pink family with a single known population;

Schiedea membranacea—a purple-flowered, cliff-dwelling perennial herb in the pink family;

Schiedea stellarioides, or laulihilihi—a subshrub in the pink family, known from one population; and

Viola kauaensis var. *wahiawaensis*—a perennial herb in the violet family (Violaceae) with white and purple flowers.



***Delissea undulata* propagated by tissue culture. Only one plant exists in the wild.**

Joan Canfield/USFWS

Because the other two Kaua'i plants in this listing rule are believed to be vulnerable but not in imminent danger of extinction, they were listed under the less critical status of threatened:

Cyanea recta, or haha—an unbranched shrub in the bellflower family with purple berries; and *Myrsine linearifolia*, or kolea—a shrub in the family Myrsinaceae.

One rule classified 25 plant species endemic to the island of O'ahu as endangered:

Chamaesyce herbstii, or 'akoko—a small tree in the spurge family (Euphorbiaceae), named for Dr. Derral Herbst, a former FWS botanist who co-authored the *Manual of the Flowering Plants of Hawaii*;

Chamaesyce rockii, 'akoko—a compact shrub or small tree in the spurge family;

Cyanea acuminata, or haha—an unbranched shrub in the bellflower family, known from fewer than 100 individuals;

Cyanea humboldtiana, or haha—a white- to magenta-flowered shrub in the bellflower family;

Cyanea koolauensis, or haha—a shrub found only in the Ko'olau Mountains;

Cyanea longiflora, or haha—a shrub in the bellflower family;

Cyanea st.-johnii, or haha—a shrub named for the late botanist Harold St. John;

Cyrtandra dentata, or ha'iwale—a sparingly-branched shrub in the African violet family, with fewer than 50 known plants;

Cyrtandra subumbellata, or ha'iwale—a white-flowered shrub in the African violet family;

Cyrtandra viridiflora, or ha'iwale—a small shrub with fleshy, heart-shaped leaves, now known from fewer than 10 plants;

Delissea subcordata, or 'oha—a shrub in the bellflower family;

Eragrostis fosbergii—a recently rediscovered perennial in the grass family (Poaceae) with only six known individuals;

Gardenia mannii, or nanu—a tree in the coffee family (Rubiaceae) with fragrant, cream-colored flowers;

Labordia cyrtandrae, or kamakahala—a yellow-flowered shrub in the family Loganiaceae, known from only 10 individuals;

Lepidium arbuscula, or 'anaunau—a gnarled shrub in the mustard family (Brassicaceae);

Lobelia gaudichaudii ssp. *koolauensis*—an unbranched shrub in the bellflower family with a single remaining population;

Lobelia monostachya—a recently rediscovered woody shrub in the bellflower family known from only eight plants;

Melicope saint-johnii, or alani—a slender tree in the citrus family;

Myrsine juddii, or kolea—a highly-branched shrub in the family Myrsinaceae;

Phyllostegia hirsuta—an erect subshrub or vine in the mint family with densely hairy stems;

Phyllostegia kaalaensis—an herb in the mint family, known from fewer than 50 plants;

Pritchardia kaalae, or loulou—a member of the palm family with 130 known individuals;

Schiedea kealiae—a cliff-dwelling subshrub in the pink family;

Trematolobelia singularis—a violet-flowered shrub in the bellflower family; and

Viola oahuensis—a yellow-flowered subshrub in the violet family.

Another listing rule extended endangered status to three plant species endemic to the island of Molokai:

Cyanea dunbarii, or haha—an unbranched shrub in the bellflower family, known from 1 population of 20 plants rediscovered in 1992;

Lysimachia maxima—a sprawling shrub in the primrose family (Primulaceae), known from a single population; and

Schiedea sarmentosa—a highly-branched shrub in the pink family.

One rule addressed 14 species from throughout the archipelago. All but one were listed as endangered:

Achyranthes mutica—a recently rediscovered shrub in the amaranth family (Amaranthaceae), known from 1 population of fewer

than 50 plants;

Cenchrus agrimonoides, or kamanomano, a perennial in the grass family;

Cyanea grimesiana ssp. *grimesiana*, or haha—a shrub in the bellflower family with magenta-striped flowers;

Cyperus trachysanthos, or pu'uka'a—a perennial, grass-like plant in the sedge family (Cyperaceae), known from three populations;

Euphorbia haeleleana—a dioecious (male and female flowers on separate plants) tree in the spurge family;

Isodendron laurifolium, or aupaka—a slender, fragrant-flowered shrub in the violet family, named for its resemblance to the laurel tree;

Panicum niibauense, or lau 'ehu—a perennial bunchgrass known from a population of 23 plants growing in a State park on the island of Kauai;

Phyllostegia parviflora—a perennial herb in the mint family;

Platanthera holochila—an erect, bog-dwelling herb in the orchid family (Orchidaceae), known from fewer than 35 plants;



Pleomele hawaiiensis

Joan Canfield/USFWS

Sanicula purpurea—a prickly-fruited perennial herb in the parsley family (Apiaceae), named for its purple flowers;

Schiedea hookeri—a sprawling or clumped perennial herb in the pink family;

Schiedea kauaiensis—an erect subshrub in the pink family, known from 15 individuals; and

Schiedea nuttallii—a subshrub in the pink family with fewer than 75 known plants.

One species that is not as severely imperiled was listed as threatened:

Isodendron longifolium, or aupaka—a slender shrub in the violet family with fragrant purple flowers.

Five Central California Plants An October 18 final rule gave protection to five plants native to the central Sierra Nevada of California. The four in greatest danger were classified as endangered:

Stebbins' morning glory (*Calystegia stebbinsi*)—a perennial herb in the morning glory family (Convolvulaceae);

Pine Hill ceanothus (*Ceanothus roderickii*)—an evergreen shrub in the buckthorn family (Rhamnaceae);

Pine Hill flannelbush (*Fremontodendron californicum* ssp. *decumbens*)—a shrub in the cacao family (Sterculiaceae); and

El Dorado bedstraw (*Galium californicum* ssp. *sierrae*)—a perennial herb in the coffee family.

The status of the fifth plant, originally proposed for listing as endangered, was found to be somewhat less critical and was listed as threatened:

Layne's butterweed (*Senecio layneae*)—a perennial herb in the aster family (Asteraceae).

The main threat facing these five plants is habitat loss. Many sites have been fragmented, damaged, or destroyed by one or more of the following: urbanization, road construction and maintenance, off-road vehicle use, herbicide spraying, mining, competition from non-native plants, unauthorized dumping, overgrazing, and suppression of wildfires.

Four California Chaparral Plants A final rule published October 7 extended protection to four plant taxa associated with southern maritime chaparral, a distinctive plant community found only along the coast of southern California and northern Baja California, Mexico. The two plants most vulnerable to extinction were listed as endangered:

Del Mar manzanita (*Arctostaphylos glandulosa* ssp. *crassifolia*)—a shrub in the heath family (Ericaceae), and

Orcutt's spineflower (*Chorizanthe orcuttiana*)—a low-growing annual in the buckwheat family (Polygonaceae).

Because the danger to the other two plants is not as immediate, they were listed as threatened:

big-leaved crown-beard (*Verbesina dissita*)—a low-growing shrub in the aster family, and

Encinitas baccharis (*Baccharis vanessae*)—a fall-blooming shrub in the aster family.

Southern maritime chaparral is a low growing, relatively open plant community frequently restricted to sandy coastal terraces, and has high species diversity.

Approximately 85 percent of this habitat has been lost to agriculture and urbanization. Most of the remaining 15 percent is on private property in San Diego County, and is subject to further habitat modification or fragmentation. The situation facing southern coastal chaparral in Baja California is much the same.

Also on October 7, a previous proposal to list two other plants was withdrawn:

short-leaved dudleya (*Dudleya blochmaniae* ssp. *brevifolia*)—a low-growing succulent in the stonecrop family (Crassulaceae). Threats to this plant have decreased since it was originally proposed for listing.

Del Mar sand aster (*Corethrogyne filaginifolia* var. *linifolia*)—an erect perennial herb with violet ray florets and yellow disk florets. Due to a taxonomic revision, this plant is no longer considered distinct from *Corethrogyne filaginifolia* var. *filaginifolia*, which is more widespread.



Cyanea grimesiana ssp. grimesiana seedling in cultivation.
Joan Canfield/USFWS

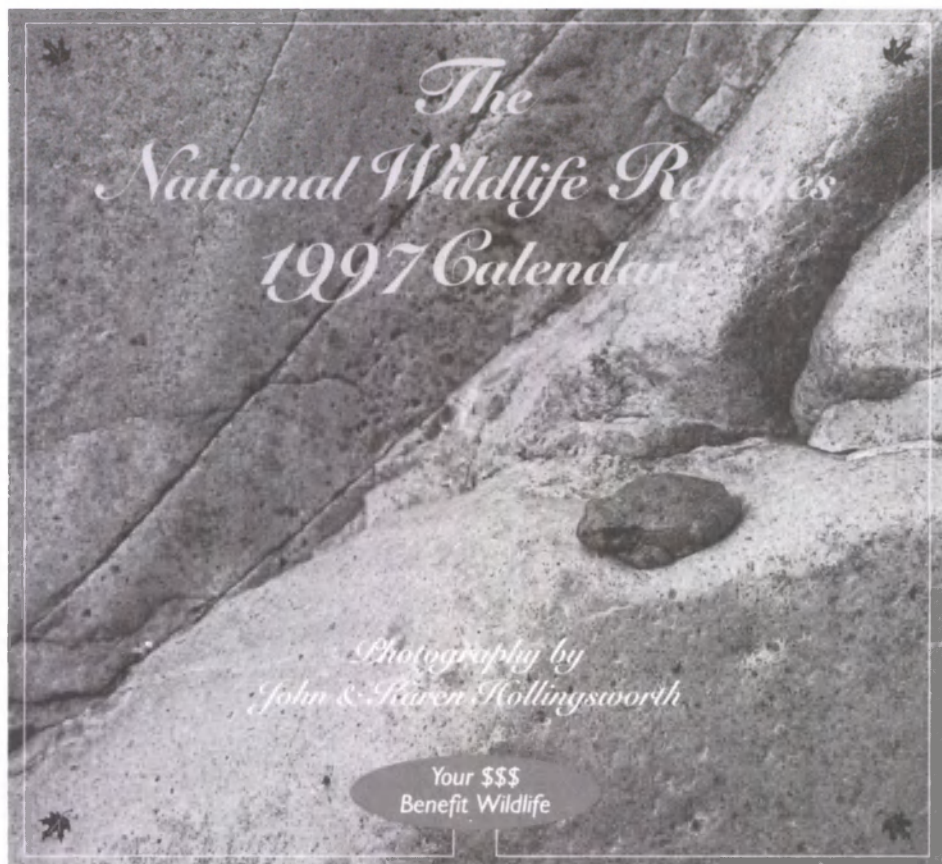
1997 Refuges Calendar Available

The extraordinary diversity of habitats and species protected in the National Wildlife Refuge System is highlighted in a new calendar featuring the work of natural history photographers John and Karen Hollingsworth. Its 24 color photographs portray ecosystems ranging from the high arctic of northern Alaska to the mangroves of southwest Florida, and wildlife from a young bull moose in the north woods of New Hampshire to a camouflaged canyon treefrog near a rocky pool in Arizona (below). An events section, *Come Discover & Learn*, contains a schedule of public activities at refuges throughout the country.

Still available is the Hollingsworths' book, *Seasons of the Wild—A Journey Through Our National Wildlife Refuges*. With more than 70 photographs and an evocative text, the book features 47 national wildlife refuges. New this year is *The Refuge Experience*, the first in a series of posters that portray a "moment in time" on the nation's refuges. The subject of this year's poster is an autumn reflection scene at Rice Lake National Wildlife Refuge in northern Minnesota.

To order the calendar, send \$12.95 to Worm Press, P.O. Box 235, Bellvue, Colorado 80512, or call 1-800-493-2713 (orders only). The price of the book is \$19.95, and the poster is available for \$12.95. As a courtesy to readers of the *Bulletin*, the normal \$3.00 per order shipping and handling charge will be waived if you mention seeing this announcement.














Under a partnership with the National Fish and Wildlife Foundation, the Hollingsworths donate 50 cents for each calendar purchased, and a portion of the proceeds from each book and poster, to the Foundation to support its conservation work on behalf of the refuge system. These contributions release an equal amount in matching funds from the Foundation to benefit refuges.



images from these publications can be viewed on-line at Refuge Net (<http://www.refugenet.com>). This new website was established by Karen Hollingsworth to support Fish and Wildlife Service outreach efforts and promote a greater understanding of the nation's refuge system.

BOX SCORE

Listings and Recovery Plans as of October 31, 1996

| GROUP | ENDANGERED | | THREATENED | | TOTAL LISTINGS | SPECIES W/ PLANS |
|---|------------|---------|------------|---------|----------------|------------------|
| | U.S. | FOREIGN | U.S. | FOREIGN | | |
|  MAMMALS | 55 | 252 | 9 | 19 | 335 | 40 |
|  BIRDS | 74 | 178 | 16 | 6 | 274 | 73 |
|  REPTILES | 14 | 65 | 19 | 15 | 113 | 30 |
|  AMPHIBIANS | 7 | 8 | 6 | 1 | 22 | 11 |
|  FISHES | 67 | 11 | 39 | 0 | 117 | 72 |
|  SNAILS | 15 | 1 | 7 | 0 | 23 | 18 |
|  CLAMS | 51 | 2 | 6 | 0 | 59 | 43 |
|  CRUSTACEANS | 14 | 0 | 3 | 0 | 17 | 5 |
|  INSECTS | 20 | 4 | 9 | 0 | 33 | 20 |
|  ARACHNIDS | 5 | 0 | 0 | 0 | 5 | 2 |
| ANIMAL SUBTOTAL | 322 | 521 | 114 | 41 | 998 | 314 |
|  FLOWERING PLANTS | 485 | 1 | 98 | 0 | 584 | 298 |
|  CONIFERS | 2 | 0 | 0 | 2 | 4 | 1 |
|  FERNS AND OTHERS | 26 | 0 | 2 | 0 | 28 | 18 |
| PLANT SUBTOTAL | 513 | 1 | 100 | 2 | 616 | 317 |
| GRAND TOTAL | 835 | 522 | 214 | 43 | 1,614* | 631** |

TOTAL U.S. ENDANGERED: 835 (322 animals, 513 plants)

TOTAL U.S. THREATENED: 214 (114 animals, 100 plants)

TOTAL U.S. LISTED: 1049 (432 animals, 613 plants)***

*Separate populations of a species listed both as Endangered and Threatened, are tallied twice. Those species are the argali, leopard, gray wolf, piping plover, roseate tern, chimpanzee, green sea turtle, saltwater/Nile crocodile, and olive ridley turtle. For the purposes of the Endangered Species Act, the

term "species" can mean a species, subspecies, or distinct vertebrate population. Several entries also represent entire genera or even families.

**There are 440 approved recovery plans. Some recovery plans cover more than one species, and a few species have separate plans covering different parts of their ranges. Recovery plans are drawn up only for listed species that occur in the United States.

***Four animals have dual status.

ENDANGERED
Species
BULLETIN

U.S. Department of the Interior
Fish and Wildlife Service
Washington, D.C. 20240

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